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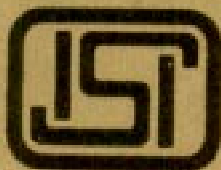
ELECTROTECHNICAL VOCABULARY

PART III ACOUSTICS

Section 4 Sonics, Ultrasonics and Underwater Acoustics

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(Continued on page 10)

Indian Standard

ELECTROTECHNICAL VOCABULARY

PART III ACOUSTICS

Section 4 Sonics, Ultrasonics and Underwater Acoustics

0. FOREWORD

0.1 This Indian Standard (Part III/Sec 4) was adopted by the Indian Standards Institution on 19 December 1966, after the draft finalized by the Electrotechnical Standards Sectional Committee, in consultation with the Acoustics Sectional Committee, had been approved by the Electrotechnical Division Council.

0.2 This Indian Standard has been prepared in view of the frequent need for definitions to be included in the different documents on amplifiers, loudspeaker and other related acoustic equipment, and with a view to bringing together the terms used in the field of acoustics. It has been decided to prepare this terminology in a number of sections, each dealing with a particular aspect of acoustics.

0.2.1 This section covers terms relating to sonics, ultrasonics and underwater acoustics.

0.2.2 The following other sections have so far been prepared:

Section 1 Physical acoustics

Section 2 Acoustical and electro-acoustical transmission system

Section 5 Speech and hearing

0.2.3 The following sections are under preparation:

Section 3 Sound recording and reproduction

Section 6 Acoustical instruments

0.3 The electrotechnical vocabulary is being prepared in several parts, each having one or more sections.

0.4 While preparing this standard attempt has been made to follow, as far as possible, the definitions proposed by the International Electrotechnical Commission in their Pub 50(08) (1960) Electro-acoustics.

0.4.1 Assistance has also been derived from the following:

B.S. 661 : 1965 Glossary of acoustical terms. British Standards Institution

ASA S 1:1-1960 Acoustical terminology (including mechanical shock and vibration). American Standards Association.

1. SCOPE

1.1 This standard (Part III/Sec 4) covers terms relating to sonics, ultrasonics and underwater acoustics.

2. SONICS

2.1 Sonics — The technology of sound in processing and analysis in any non-communication process.

NOTE — The term *sonic* (distinct from *sonics*) is an adjective derived from the term sound and used to refer to the speed of sound in air (*see* 2.6 of Section 1).

2.2 Macrosonics — The technology of sound at amplitudes so large that linear approximations are not valid.

NOTE — Processing techniques usually involve macrosonics.

2.3 Sonic Flaw Detection — The process of locating imperfections in solid materials by observing internal reflections or variations in transmission through the materials as a function of sound-path location.

2.4 Sonic Agglomeration — The union of small particles suspended in a fluid medium into larger aggregates by the action of sound waves.

2.5 Sonic Cleaning (Degreasing) — The cleaning of contaminated materials by the action of intense sound in the liquid in which the material is immersed, usually involving cavitation.

2.6 Sonic Drilling — The process of cutting or shaping materials with an abrasive slurry driven by a reciprocating tool attached to an electromechanical transducer.

2.7 Sonic Soldering — The method of joining metals by metallic bonding alloys through the use of mechanical vibrations to break up the surface oxides.

2.8 Sonic Surgery — The use of focussed ultrasound to produce precisely circumscribed alterations at predetermined sites within the living tissue.

2.9 Sonic Cavitation — The formation, growth and collapse of gaseous and vapour bubbles in a liquid due to the action of intense sound waves.

2.10 Cavitation Noise — The noise produced in a liquid by cavitation.

2.11 Oseen Force — A steady force exerted on a suspended particle by second-order velocity effects resulting from second harmonic content in a sound wave.

2.12 Sonoluminescence — The luminescence produced in some liquids by sonic energy.

2.13 Sonic Viscometry — Determination of the coefficients of viscosity of liquids or slurries by the measurement of acoustic properties of a transmitted wave or by the reaction of such a medium on a transducer.

2.14 Molecular Relaxation — Equalization of energy among the degrees of freedom of a molecule following a disturbance that produces deviations from the equilibrium distribution.

2.15 Relaxation Time — The characteristic time interval required for regaining equilibrium after the removal of a perturbation.

2.16 Pressure-Gain Factor — The ratio of the peak pressure amplitude of a focusing transducer at the focus to that at the radiating surface.

2.17 Sonic Applicator, Medical — An electromechanical transducer with its associated equipment designed for local application of sound energy for therapeutic purposes.

2.18 Hydrodynamic Oscillator — A transducer for generating sound waves in fluids, in which a continuous flow through an orifice is modulated by a reciprocating valve system controlled by acoustic feedback.

2.19 Jet-Edge Sonic Generator — A fluid dynamic transducer, involving vortex formation, in which stabilization is achieved by hydrodynamic feedback between a jet and an edge.

3. ULTRASONICS

3.1 Ultrasonics — The science and technology of sound at frequencies above the audio range.

NOTE — *Ultrasonic* : Disturbances of frequency too high to be capable of exciting the sensation of hearing.

Infrasonic : Disturbances of frequency too low to be capable of exciting the sensation of hearing.

3.2 Ultrasonic Generator (Ultrasonic Transmitter) — A device for the production of ultrasonic energy.

3.3 Ultrasonic Detector (Ultrasonic Receiver) — A device for detection and measurement of ultrasonic energy.

3.4 Ultrasonic Stroboscope — An interrupter of light whose action is based on the modulation of a light beam by an ultrasonic field.

3.5 Ultrasonic Light Diffraction — The formation of optical diffraction spectrum when a beam of light traverses a field of longitudinal sound waves. Diffraction results from the periodic variation of the index of refraction.

3.6 Ultrasonic Grating — A grating formed due to periodic variations in density, and hence in refractive index, caused by ultrasonic waves in a medium.

3.7 Ultrasonic Space Grating — A periodic spatial variation of the index of refraction caused by the presence of acoustic waves within a medium.

3.8 Ultrasonic Grating Constant (Space Grating Constant) — The distance between adjacent diffracting centres in an ultrasonic grating (space grating).

3.9 Ultrasonic Mode Changer — A device which causes vibrations of a particular mode (for example, longitudinal) on one body to produce vibrations of another mode (for example, shear) in another body.

3.10 Ultrasonic Image Converter — A device for making acoustic field configurations optically visible.

4. UNDERWATER ACOUSTICS

4.1 Underwater Sound Projector — An electro-acoustic transducer used to produce sound in water.

4.2 Hydrophone — An electro-acoustic transducer that transforms water-borne acoustic signals into electrical form.

4.3 Hydrophone or Underwater Projector Array — An array of hydrophones or underwater projectors suitably arranged to provide a desired directivity pattern.

4.4 Shading — A method of controlling the directional response pattern of a transducer through the control of distribution of phase and amplitude of the transducer action over its active face.

4.5 Sonar — A method or equipment used for determining the presence or location or both of the objects under water by sound.

NOTE — The word SONAR is an acronym derived from the expression 'Sound Navigation and Ranging' and is also known by the term ASDIC which is an acronym derived from the expression 'Anti Submarine Devices Investigation Committee'.

4.6 Active Sonar (Echo-Ranging Sonar) — A method or equipment by which information about an object under water is obtained by evaluating the echo of sound generated by the equipment received on reflection from the object.

4.7 Passive Sonar (Listening Sonar) — A method or equipment by which information concerning an object under water is obtained by the evaluation of sound generated by the object.

4.8 Sonar Background Noise — The total noise that interferes with the reception of the desired signal. It is that noise which is presented to the final receiving element, such as a recorder or the ear of a listener.

4.9 Sonar Self-Noise — That part of the sonar background noise which is produced by the equipment carrying the hydrophone and by the motion of water relative to the hydrophone and its associated equipment.

4.10 Underwater Ambient Noise — That part of the sonar background noise which is due to disturbances in the medium (water). This includes noise produced by marine life, terrestrial noise, sea noise, rain noise and man-made noise.

4.11 Sea Noise — Part of the underwater ambient noise, excluding terrestrial noise, precipitation and man-made noise and that contributed by marine life.

4.12 Underwater Reverberation — The received sound due to scattering from the surface (*surface reverberation*), the bottom (*bottom reverberation*) and the body of the sea (*volume reverberation*).

4.13 Reverberation Limited Condition — A condition in which detection is limited by the reverberation part of the sonar background noise. This condition ordinarily occurs only with active sonar.

4.14 Noise Limited Condition — A condition in which detection is limited by sonar background noise other than underwater reverberation.

4.15 Transmission Loss Between Two Points of an Underwater Transmission System — The decrease in intensity expressed in decibels. In underwater sound one of the points is usually taken one metre from the effective acoustic centre of the source of sound.

4.16 Sonar Dome — A sound-transparent enclosure for the underwater sound projector.

4.17 Sonar Dome Insertion Loss — The increase in transmission loss caused by the addition of a sonar dome between the electrical terminals of a specified transducer and an external field point at which transmission or reception of sound occurs.

NOTE — The dome insertion loss is usually expressed in decibels for a specified direction of transmission.

4.18 Sonar Dome Loss Pattern — A description, often presented in a graphical form, of the dome insertion loss as a function of the direction of sound transmission relative to the reference axis of the dome.

4.19 Shadow Zone — Region, formed under certain conditions of thermal stratification of the sea, not penetrated by the sound beam from a sonar.

4.20 Target Strength — The ratio of the mean square sound pressure scattered by the object referred to unit distance (one metre) in a specified direction to the mean square sound pressure of the incident plane wave. When referring to ' Back-Scattering ' as is usually the case, the specified direction is that from which the incident sound has come. Target strength is sometimes referred to as the ' Scattering Differential '.

NOTE 1 — The terms 'Target Strength' and 'Scattering Differential' are also used when the scattered mean square sound pressure is averaged over all directions and not only that in a specified direction.

NOTE 2 — The target strength of a sphere of radius 'a' metre expressed in decibels is $20 \log a^2$. A sphere of 2-metre radius has a target strength of zero decibel, thus providing a reference target level.

NOTE 3 — Actual measurements shall be made at such a distance that the sound appears to be scattering from a single point called the acoustic centre.

4.21 Flow-Excited Noise — Noise other than cavitation noise resulting from the motion of a body through the water. This noise is often enhanced by the vibration of the body.

4.22 Singing in Underwater Sound — A special form of flow-excited noise in which a body (often a propeller) is excited and maintained in oscillation at discrete frequencies.

4.23 Standard Sea-Water Conditions — Under consideration.

4.24 Scattering Cross-Section — An area numerically equal to 4π times the target strength and measured in units equal to the square of the unit radius. The scattering cross-section per unit solid angle is thus the target strength.

NOTE — The term 'Scattering Cross-Section' is also used when the scattered mean square pressure is averaged over all directions.

4.25 Scattering Strength (Reverberation Strength) of a Surface or Volume — The target strength per unit area or unit volume.

4.26 Scattering Coefficient — 2π and 4π times the scattering strength for a surface and a volume respectively.

4.27 Transmission Anomaly — The transmission loss after allowing for geometrical spreading, commonly spherical spreading.

4.28 Spreading Loss — The loss directly associated with spreading, that is, with the increasing area over which the sound energy (otherwise of constant intensity) is distributed. Common forms of spreading are:

- a) spherical spreading, where the transmission loss increases by 20 decibels per ten-fold increase in range (approximately 6 decibels with a doubling of range);
- b) cylindrical spreading, where the transmission loss increases by 10 decibels per ten-fold increase in range (approximately 3 decibels per doubling of range); and

- c) dipole spreading, where, in special circumstances, for example, near the surface of the sea, and due to total internal reflection the loss may be 40 decibels per ten-fold increase in range (approximately 12 decibels per doubling of range).

4.29 Underwater Sound Attenuation — The whole of the transmission loss other than that due to spreading. It includes scattering, absorption and boundary losses.

4.30 Sound-Velocity Gradient — The maximum space rate of change of sound velocity due to a change of temperature, salinity and density.

4.31 Shallow Water — An underwater region where the depth is very much less than $\sqrt{r\lambda}$, r being the range at which sound intensity is to be determined, and λ the wavelength of the sound wave used.

4.32 Deep Water — An underwater region where the depth is very much greater than $\sqrt{r\lambda}$, r being the range at which sound intensity is to be determined, and λ the wave length of the sound wave used.

4.33 Underwater Sound Channel — A channel which occurs when sound velocity or depth profile shows a minimum. It may be a deep, shallow or surface sound channel.

NOTE 1 — The main channel is also known as the SOFAR channel, the word being an acronym for ' Sound Fixing and Ranging '.

NOTE 2 — The surface sound channel is usually due to wind mixing and produces a homogeneous layer, and is, therefore, sometimes referred to as a mixed layer.

4.34 Convergence Zone — A region, where focussing of the rays occurs as a result of refraction, first downwards and then upwards.

NOTE 1 — Such rays are sometimes called deep refracted rays.

NOTE 2 — Usually, such a region occurs at a distance of 25 to 55 km from the source.

4.35 Multi-Path Effects — Effects due to a multiplicity of sound waves arriving along different ray paths or in different modes.

4.36 Layering — The approximate horizontal stratification of many of the properties of the sea, such as temperature, salinity, density and sound velocity.

4.37 Scattering Layer — A layer in which scattering elements (usually of biological origin) are concentrated.

4.38 Thermocline — A region where variation of temperature with depth is large.

NOTE — In the region of thermocline, generally the temperature decreases with depth.

4.39 Halocline — A region where variation of salinity with depth is large.

4.40 Critical Ray — A ray incident on the bottom at the critical angle for total reflection.

4.41 RSR Propagation — The mode of propagation by successive deep refractions (R) and surface reflections (SR).

4.42 Limiting Ray — A ray which forms part of the boundary of the shadow zone. Other parts of the boundary may be marked by a caustic line or focussing of rays.

4.43 Split-Beam Ray — A horizontal ray that is refracted upwards and downwards at a depth where there exists a maximum velocity gradient, leaving a shadow zone in between.

(Continued from page 2)

Panel for Acoustical Terminology, ETDC 27/P3

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INDEX

NOTE — This index has been prepared in accordance with IS: 1275-1958*. Index numbers are clause numbers.

A

Active sonar 4.6
Agglomeration, Sonic 2.4
Anomaly, Transmission 4.27
Applicator, Sonic medical 2.17
Array, Underwater projector 4.3
Attenuation, Underwater sound 4.29

B

Background noise, Sonar 4.8

C

Cavitation noise 2.10
Sonic 2.9
Changer, Ultrasonic mode 3.9
Channel, Underwater sound 4.33
Cleaning, Sonic 2.5
Coefficient, Scattering 4.26
Constant
 Space grating 3.8
 Ultrasonic grating 3.8
Convergence zone 4.34
Converter, Ultrasonic image 3.10
Critical ray 4.40
Cross-section, Scattering 4.24

D

Deep water 4.32
Degreasing 2.5
Detection, Sonic flaw 2.3
Detector, Ultrasonic 3.3
Diffraction, Ultrasonic light 3.5
Dome, Sonar 4.16
Drilling, Sonic 2.6

E

Echo-ranging sonar 4.6
Effects, Multi-path 4.35

F

Factor, Pressure-gain 2.16
Flaw detection, Sonic 2.3
Force, Oseen 2.11

G

Gain factor, Pressure 2.16
Gradient, Sound velocity 4.30
Grating
 constant, Ultrasonic 3.8
 Ultrasonic 3.6
 Ultrasonic space 3.7

H

Halocline 4.39
Hydrodynamic oscillator 2.18
Hydrophone 4.3

I

Image converter, Ultrasonic 3.10
Insertion loss, Sonar dome 4.17

J

Jet-edge sonic generator 2.19

L

Laycring 4.36
Layer, Scattering 4.37
Light diffraction, Ultrasonic 3.5
Limiting ray 4.42
Listening sonar 4.7
Loss
 pattern, Sonar dome 4.18
 Sonar dome insertion 4.17
 Spreading 4.28

M

Medical, Sonic applicator 2.17
Mode changer, Ultrasonic 3.9
Molecular relaxation 2.14
Multi-path effects 4.35

N

Noise
 Cavitation 2.10
 Flow excited 4.21
 limited condition 4.14
 Sea 4.11
 Sonar self 4.9
 Sonar background 4.8
 Underwater ambient 4.10

O

Oscillator, Hydrodynamic 2.18
Oseen force 2.11

P

Passive sonar 4.7
Pressure-gain factor 2.16
Propagation, RSR 4.41

R

Ray,
 Critical 4.40
 Limiting 4.42
 Split beam 4.43

*Rules for making alphabetical indexes.

IS : 1885 (Part III/Sec 4) - 1966

Receiver, Ultrasonic 3.3

Relaxation,

Molecular 2.14

time 2.15

Reverberation

limited conditions 4.13

strength of a surface or volume 4.25

Underwater 4.12

RSR propagation 4.41

S

Scattering

cross-section 4.24

coefficient 4.26

strength of a surface or volume 4.25

layer 4.37

Sea noise 4.11

Shading 4.4

Shadow zone 4.19

Shallow water 4.31

Singing in underwater sound 4.22

Sonar 4.5

Active 4.6

background noise 4.8

dome 4.16

insertion loss 4.17

loss pattern 4.18

Passive 4.7

Self-noise 4.9

Sonic

agglomeration 2.4

applicator, medical 2.17

cavitation 2.9

cleaning 2.5

drilling 2.6

flaw detection 2.3

generator, Jet-edge 2.19

Soldering 2.7

surgery 2.8

viscometry 2.13

Sonics 2.1

Sound

attenuation, Underwater 4.29

channel, Underwater 4.33

projector, Underwater 4.1

velocity gradient 4.30

Sonoluminescence 2.12

Space grating, Ultrasonic 3.7

Split-beam ray 4.43

Spreading loss 4.28

Standard sea-water conditions 4.23

Strength, Target 4.20

Stroboscope, Ultrasonic 3.4

T

Target strength 4.20

Thermocline 4.38

Time, Relaxation 2.15

Transmission anomaly 4.27

loss between two points of an

underwater 4.15

Transmitter, Ultrasonic 3.2

U

Ultrasonic

detector 3.3

generator 3.2

grating 3.6

image converter 3.10

light diffraction 3.5

mode changer 3.9

receiver 3.3

space grating 3.7

stroboscope 3.4

transmitter 3.2

Ultrasonics 3.1

Underwater

ambient noise 4.10

reverberation 4.12

projecting array 4.3

Sound

attenuation 4.29

channel 4.33

projector 4.1

singing in 4.22

V

Viscometry, sonic 2.13

W

Water

Deep 4.32

Shallow 4.31

Z

Zone

Convergence 4.34

Shadow 4.19

INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

Base Units

Quantity	Unit	Symbol
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

Quantity	Unit	Symbol
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

Quantity	Unit	Symbol	Conversion
Force	newton	N	1 N = 1 kg.m/s ²
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m ²
Frequency	hertz	Hz	1 Hz = 1 c/s (s ⁻¹)
Electric conductance	siemens	S	1 S = 1 A/V
Pressure, stress	pascal	Pa	1 Pa = 1 N/m ²

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